Changes in personal disposable income (PIR) accounted for 12.6% of total stimulation nationally and roughly 10% and 12% of total stimulation within Ohio and Indiana. Disposable income is an excellent variable for explaining differences in penetration levels between states. State data show a very high correlation between state average personal disposable income and statewide penetration rates. States with low personal income relative to national averages also have low penetration levels. This, of course, is why the PIR variable was estimated with a high level of statistical significance within the LOGDEP model. The logical policy question arising from the PIR coefficient is how Lifeline programs can be designed to offset the effect of low statewide average personal income. This topic is discussed in more detail below.

Lastly, the combined Lifeline and Link-up binary variable continues its dismal showing. The national analysis indicates that the presence of Lifeline and/or Link-up programs generates only a 1% increase in penetration. This equates to roughly 105 000 RBOC lines in 1992. California alone had over 1 700 000 Lifeline customers in 1992. Thus the LNF variable fails to provide much meaningful information. One clear conclusion from the LNF results, however, is that there are such dramatic differences in the degree to which individual states have pursued Lifeline programs that a national-level analysis using only a binary variable to pick up the effects of Lifeline programs is inadequate.

Reviewing the combined estimated penetration effects across all variables for Ohio, Indiana and the national average shows mixed results. The Ohio model results explain 78% of the change in penetration. The Indiana results fall apart as penetration in Indiana went against the national trend by actually declining over the period 1985 through 1992. The model specification, which provides national-level estimates for all coefficients except the intercept, fails to provide a meaningful explanation of the penetration changes in Indiana. The Ameritech SLCR variable in Indiana was considerably higher due to the intrastate SLC while the RR1 rate also enjoyed a larger change than the weighted national RR1. Indiana also experienced above-average gains in personal disposable income. An explanation of the penetration decline in Indiana will require a separate study focused specifically on Indiana. The national results, as is expected given a national model, are superior to either state. The model 'accounts' for 87% of the total penetration change at the national level.

Areas for further study

There are several ways that the modeling efforts outlined in this paper can be improved. First, the model estimates statewide relationships between penetration, disposable income, Lifeline programs, etc, based on data from only Bell operating companies. Statewide penetration analysis will be improved by obtaining company-specific data for at least the largest three LECs in each state. Gathering this additional data will significantly increase the size and richness of the data set. Gathering historical RR1 data and measured service rates for the non-Bell LECs, however, promises to be nearly impossible. The analysis presented in this paper was largely made possible through the NARUC study of RBOC residential dialtone rates. Unless similar documentation can be found for the other large LECs, the chances of pulling together non-Bell dialtone rates without considerable expenditures in time are slim.

A second necessary area for additional study is to include variables

for measured-rate dialtone services. These variables proved very important in the Perl study for measuring the effect of policy variables on penetration. These data are contained within the NARUC study and are thus obtainable. Adding these variables along with data for 1993 will probably add significantly to the model results.

Another variable worth including in the analysis is a measure of local calling scope. Strong variation in local calling scope across the country is not recognized at statistically significant levels in the current models.[12] With the rise of extended area service and countywide calling plans, customers are receiving considerably more value from their basic dialtone service. Given the strong results associated with the toll pricing variable, it is logical that transforming a portion of the intrastate intra-LATA toll market into an expanded dialtone service will stimulate penetration.

In terms of addressing the question of whether a natural rate of non-pentration exists, studies must focus on households without telephone service and model the factors driving these households' decisions. In order to gain additional insight on the natural rate of non-penetration, a closer examination of households that do not subscribe to telephone service is needed. Some explanatory factors like disposable income, calling scope and price are easy to model. Other explanatory factors like fear of privacy invasion and religious beliefs will require more extensive and directed survey research to identify and quantify. Several studies have broken ground in this area.[13] Once models describing non-penetration have been developed and reviewed, state and federal policy makers can make more informed comparisons of the differences between states and the effects of explanatory variables on penetration levels. These analyses may then allow the policy debate to focus program efforts away from demographic, religious and other factors affecting penetration which are not addressable through policy efforts and toward programs like service pricing, calling scope and service quality which may be positively influenced through regulatory programs.

Policy issues

There are two primary areas to consider when reviewing support policies for universal service: how to stimulate dialtone demand so as to increase penetration; and how to collect the funds used to finance the support programs. Each of these policy areas is discussed briefly below using information obtained from the modeling efforts.

How to support end users?

The first and most obvious method for stimulating demand and increasing penetration is to reduce basic dialtone rates. As the data used in the models indicate, dialtone pricing (in real dollars) has been declining over the last decade. This trend has aided the slow but steady increase in penetration. As competition emerges more vigorously in the LEC markets, however, LECs may be forced to rely more heavily on the dialtone markets for contribution to joint and common costs. Historically, LECs and regulators have sought to establish price structures which minimize the dialtone services' obligations for recovering joint and common costs.[14] As competition reduces margins in the LECs' toll and

[12] The Perl study uses both telephone density and number of subscribers within the local calling area as proxies for calling scope and estimates the effects of calling scope on demand with some success. Interestingly, however, the Perl study indicates that very high telephone densities experienced in urban centers reduce penetration levels. With the recent creation of countywide calling plans and 40–70 mile calling radius plans, data may be available to better gauge the effects of expanding calling scopes on penetration.

[13] Zimmerman, Unbie 'The telephone comes to Pennsylvania Amish country: a study of resistance to technology at the turn of the century' Paper presented at the 39th Annual International Communications Association, May 1989; and *Michigan Bell Telephone Company: Deregulation, Cost Allocations, Rate Design, Universal Service* National Consumer Law Center (1990)

[14] An example of regulatory policy designed to prevent dialtone service from providing large contribution levels to common costs is the federal high cost assistance program. Under this program LECs with high average loop costs draw revenues from a federal fund collection through fees charged to IXCs. The purpose of this fund is to alleviate the upward pressure on the dialtone rates of LECs with high loop costs.

access markets, LECs and regulators may be required to allow dialtone to pick up the slack.

There are several ways for LECs to reduce the effects of upward price pressure for dialtone services on penetration levels.[15] First, the presence of local measured service (LMS) options for customers was clearly shown by the Perl study to benefit demand. The low flat-rate monthly recurring charge allows customers to connect to the public switched network at less expense provided that their monthly usage is under control. For low-income customers with limited usage but who need connection to the telephone system to receive calls and have access to emergency services like E-911, LMS service provides an excellent solution.[16]

In addition to providing LMS, expanded efforts for enrolling qualified customers into existing Lifeline programs promise to increase penetration.[17] Existing Lifeline programs provide for greatly discounted monthly local service rates for customers that meet income criteria. As noted above, subscribership in Lifeline programs is generally very small relative to the base of qualifying customers. There are many reasons for this and studies have been done which partially explain this problem.[18] The policy question to answer is what level of administrative expense associated with continually monitoring and publicizing Lifeline programs is justified given the benefits. More thorough analysis of this policy question will be needed as competition in the toll and access markets put upward pressure on local service rates.

A more controversial, and probably less influential, method for stimulating demand for dialtone is to allow Lifeline customers to purchase custom calling features that enhance the value they receive from their telephone services. As an example, a small subset of customers may decide that their privacy concerns mandate that services like Caller ID or Selective Call Rejection must be purchased along with dialtone. If the combined package of dialtone and the custom calling features are beyond their financial grasp, they will simply choose not to purchase any of the services. If these customers meet the income criteria to subscribe to the Lifeline programs, the price break on dialtone may allow them to purchase the entire package that they require.

Another way to control the end users' overall telephone bill is to provide free toll blocking. Some customers find that their inability to control their long-distance calling generates monthly toll bills that they are unable to pay. Combined with this problem, their household income makes the purchase of both undiscounted dialtone and toll blocking service too expensive. For a select group of low-income customers, providing free toll blocking service will probably stimulate demand for basic local service. Free toll blocking may in fact prove more effective in controlling the customers' total bills and stimulating demand than discounting dialtone rates.

There are, however, several concerns associated with providing free toll blocking. The first concern is that toll blocking is a viable and profitable calling feature offered by the LECs. Unless the program to provide this service free is carefully crafted and implemented, demand for the toll blocking service may be reduced to the point where the service is no longer profitable and must be pulled from the market. In addition, similar to universal service support functions, the costs for administering and monitoring the free toll blocking program must be kept under control. A logical solution for limiting the impact on existing

[15]As competition emerges in the LEC markets and the LECs are allowed to function more like competitive rather than fully regulated firms, LECs will probably be able to reduce costs. This increase in efficiency will reduce upward pressure on dialtone rates. The remainder of this section focuses on pricing and explicit subsidy support mechanisms for fostering universal service.

[16]Considerable controversy arises when LECs petition to eliminate flat-rate dialtone service and require customers to subscribe to LMS. If the goal is to foster penetration, LMS offerings should be added to, and not replace, existing flat-rate dialtone services. Another concern regarding LMS plans is the cost of providing LMS service. Central office software upgrades and billing system changes to handle the measurement and billing of LMS service generate significant expenses. It is possible that increased spending on existing support programs will provide superior results per dollar spent than implementing LMS.

[17]The FCC Link-up program has been implemented in every state except Delaware and California. California has a similar program in place for discounting service connection charges. Lifeline programs for discounting residential bills to offset federally mandated SLC charges are currently offered in 37 states. For more information see *Trends in Telephone Service Industry Analysis Division, FCC, Washington, DC* (May 1994).

[18]Johnson *op cit* Ref 9

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toll blocking customers is to provide free toll blocking only to Lifeline customers. While it does not seem logical to provide free toll blocking to a customer who has Lifeline and is purchasing Caller ID, this question is the fodder for future policy debates.

Another method for increasing penetration is to either discount service connection rates or allow customers to pay off service connection rates over a period of time. Both the modeling efforts presented in this paper and the Perl study clearly indicate that service connection pricing is an important factor for explaining demand for residential dialtone service. Discounting service connection charges, however, is already being implemented through the FCC's Link-up program. Rather than creating new programs, increasing public awareness and subscribership to the existing program by qualifying families may be needed to increase penetration. The more difficult question of how to fund administrative and program expenses is discussed below.

Finally, the model indicates that reducing toll rates will stimulate penetration. As the LECs' toll markets are limited to the intra-LATA toll markets, requiring LECs to reduce their toll rates or provide reduced toll rate services to low-income customers may prove relatively ineffective in stimulating demand. More on point for this topic is the question of how universal service support mechanisms should be funded. The next section discusses this issue in more detail.

How should universal service support programs be funded?

Existing universal service support programs are funded primarily through charges levied on IXCs based upon their share of the toll market.[19] By assessing these costs on IXCs, the programs are funded through artificially high toll rates charged by the IXCs. The model presented in this paper and the HTB study strongly show that reduced toll rates stimulate dialtone demand. As a result of this relationship, requiring toll services to function as the funding source for universal service programs is somewhat counterproductive. The benefits of increased demand through lower dialtone pricing are partially offset through repressed demand associated with higher than necessary toll rates.

Removing the universal service support funding burden from the toll industry will result in lower toll pricing and stimulated dialtone demand. The current interstate toll market is intensely competitive and reductions in costs from eliminating the support mechanism would be passed on to consumers in the form of lower toll pricing very quickly. Of course, great care must be taken to ensure that the new mechanism for funding the universal service programs is not worse than the original.

Based on the results of the modeling efforts discussed in this paper and both the Perl and HTB studies, a case can be made that support mechanisms for universal service programs should be maintained wholly within the local dialtone market. Following this argument, existing and future support programs should be funded in a competitively neutral fashion by all companies that provide local dialtone service. A logical way to accomplish this is to require all dialtone providers to charge a uniform statewide dialtone additive charge to support the universal service programs. The costs of administering the programs along with the value of the discounts provided to customers can be added together and divided by total loops provided within the state by all companies. Each company will then remit to the supporting fund based upon their

[19]IXCs are assessed charges to support the FCC's high cost assistance fund, SLC offset program and Link-up. The assessments are made based upon each presubscribed dialtone line.

total loop count. In this fashion the additive to each company's local service rates will be identical and no firm will be disadvantaged through the funding mechanism. Of course an even better method for funding local dialtone subsidy programs is through general tax revenues. This funding method, however, has little realistic chance for widespread implementation.

An important characteristic of the funding proposal described above is that the access and toll markets will not provide an explicit subsidy for dialtone service.[20] As competition evolves in the dialtone, access and toll markets, the age-old concept of the toll-to-local subsidy, which evolved into the access-to-local subsidy, must be eliminated. At some point the industry will no longer be able to play pass the local subsidy without affecting competition and/or equity within the markets. Limiting subsidies to highly targeted programs which are paid for on a competitively neutral basis through a funding system that is wholly contained within the dialtone market will provide a large step in resolving issues surrounding the toll-to-local and access-to-local subsidies. Expanding the Lifeline programs and altering the way they are funded may provide a framework to accomplish these goals.

The alternative to maintaining universal service support funding within the dialtone market is to require all telecommunications firms to participate in the funding burden. While there are complications associated with this, as noted above, this argument also has considerable merit. First, this form of funding has been in place for many years and is well understood. Second, virtually all telecomunications firms benefit from the existence of the local loop and dialtone service. As such, it is logical that all firms benefiting from the service should pay to support demand for dialtone.

The second question to address is how the universal service support funds should be distributed. The two most logical distribution methods are to distribute the funds directly to customers that qualify for support or to distribute funds to the dialtone companies based upon qualifying customer counts. Providing telecommunications vouchers or coupons directly to customers would provide a funding system similar to the federal food stamp program. Unless the vouchers are sufficiently limited to the individual to whom they are issued, a market for the vouchers may develop which would undermine the success of the program. In addition to this difficulty, the administrative cost of maintaining a voucher/coupon program promises to be higher than the alternatives. For these reasons, payment directly to dialtone companies based upon their total count of qualifying customers appears to be the superior solution. On an annual or other periodic basis, companies would submit their eligible line count to a fund administrator for reimbursement. Significantly more analysis of potential problems and administrative costs associated with these two funding mechanisms is needed. The FCC's pending Notice of Inquiry in docket CC No 80-286 promises to generate the needed policy debates and facts.

Conclusions and recommendations

The modeling efforts developed and presented within this paper served to reinforce the results of several prior studies. Dialtone and service connection rates along with toll pricing are all important variables for predicting dialtone demand behavior. In addition, the varied success of

[20]The access and toll markets will continue to generate contributions to the LECs' joint and common costs. This contribution has been characterized by some parties as untargeted subsidies to the LECs. In reality, all multiproduct companies have joint and common costs (including profits) built into their prices; LECs are no different. The critical goal for fostering competition in the LEC markets is to design regulatory policies which allow LECs to compete while market pressures determine the LECs' profitability and where the LECs will be able to recover their joint and common costs. At the same time, and to the extent needed, an explicit or targeted subsidy system supporting individuals can be created to maintain the regulatory policy goal of universal service.

Lifeline programs across the country have prevented the Lifeline and Link-up variable from proving significant. As competition evolves in the LEC markets and upward pressure is placed on dialtone rates, the industry and regulators will probably pursue Lifeline programs more vigorously. This process should improve the prospects for successfully measuring the impact of these programs on dialtone.

In terms of determining whether there exists a natural asymptote for penetration at either the state or national level, the model results are disappointing. The data set and/or model specification were insufficient for identifying this characteristic of residential penetration. Expanding the data set back into the past, which promises to be a difficult undertaking, or allowing time to enrich that data set will be necessary to improve the modeling prospects. A necessary alternative to expanding the existing model is to model households that do not subscribe to dialtone service. Research studies focusing on non-penetration probably holds more promise for estimating whether and at what level an asymptote exists.

The policy recommendations for improving penetration levels based upon the modeling efforts are as follows:

- Offer LMS in addition to flat-rate dialtone service.
- Support policies which result in lower toll prices.
- Support industry efforts to spend additional money promoting Lifeline programs.
- Allow Lifeline customers to purchase ancillary services.
- Provide free toll blocking to qualifying customers.
- Continue the programs to discount service connection charges and allow time payments.

Several of these policy recommendations are controversial and will undoubtedly receive spirited debate in the comment rounds of the FCC's Notice of Inquiry for universal service support.